Effect of Recurrent Bruising on the Processing of Red Tart Cherries

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THE INTRODUCTION OF mechanical harvesting of red cherries is creating a need for widespread changes in the industry. New and improved methods of handling, holding, sorting, and processing are desirable.

No single factor places greater restrictions on the development of new methods than does bruising; the tender cherry is not designed for rough handling. Yet cherries must indeed be subjected to a series of potential bruising steps prior to and during processing.

At present, considerable attention is being focused on the bruise damage associated with mechanical harvesting (5, 6, 11, 13, 18). Effects of the additional and often severe bruising caused by various handling, sorting, and processing operations are largely unknown.

The purpose of this study was to obtain quantitative information on the bruising of cherries. In a laboratory, cherries were given recurrent bruising treatments which closely simulated those occurring in commercial practice. Responses of the cherries were measured in terms of scald development, change in weight, and yield of pitted fruit. It is hoped that the findings will be useful in the development of new commercial scale handling and processing procedures.

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EXPERIMENTAL METHODS

Cherries were carefully picked with attached stems in two orchards near Traverse City, Michigan. Immediately after stem removal in the laboratory, the cherries were weighed and given a standard bruising treatment comprising two drops from a height of 3 feet onto a porcelain tray. Previous studies (13, 15, 18) have shown that this amount of bruising approximated that of average hand or machine harvesting. The cherries were then treated approximately as in lug and water handling. Some samples were immediately placed in air in constant temperature rooms at 50°F. and 78°F., and others were soaked in water at 50°F. and 78°F. After 3, 6, and 24 hours some of the samples were rebruised in the manner described previously. Thus four stages of bruising were studied, corresponding to bruising at (a) harvest time, (b) receiving or sorting station, (c) unloading at a processing plant, and (d) conveyance through a plant after a soak period. It is not known whether the standard bruise (two drops from 3 ft.) was more or less severe than that occuring in commercial practice at stages b, c, and d, as observations indicated wide variations in bruising at these stages. With samples held at 78°F., bruising at stages c and d was omitted, owing to deterioration of the cherries.

Twenty-four hours after stem removal, the cherries were blotted free of surface water and weighed. Scald was estimated by visual examination. The cherries were pitted with a 6-needle laboratory pitter, drained for five minutes on a sieve, and weighed. Samples used for firmness and drained weight determinations were boiled for one minute on a hot plate. Drained weight percentages were obtained by dividing drained weights by original weights after stem removal. The percentages, therefore, represented total processed yields after handling, pitting, and cooking losses. No culls were removed after the tests began.

The treatments were repeated with cherries from the same orchard in 1960, 1961, and 1962. In 1962, cherries from a second orchard were tested. In all cases, similar effects of bruising were obtained.

RESULTS AND DISCUSSION

Quality and Yield

The effects of recurrent bruising of cherries held in 50°F. water for 24 hours are shown in Table 1. As the number of bruises increased, scald blemishes increased (from 0 to 76 percent), the weight of whole cherries decreased (from +4.6 percent to −8.6 percent), and the yield of pitted fruit decreased (from 88.7 percent to 74.0 percent). Similar effects of bruising were obtained with cherries held in the air at 50°F. Repeated bruisings, therefore, had detrimental and cumulative effects on quality and yield. Although once-bruised cherries may recover and develop relatively tough flesh within a few hours (4, 7, 10, 14), they remain susceptible to further damage by recurrent bruising.

Scald

These findings indicate that water (or air) at 50°F. is sufficiently cool to prevent scald development in average mechanically harvested cherries, provided the cherries are cooled immediately after harvest and no further bruising occurs. If, however, the cherries are handled roughly at a receiving station or processing plant, scald blemishes may develop even though a cool temperature is maintained. This result has been observed in commercial practice. Close cooperation between grower and processor in avoiding secondary and tertiary bruising is therefore desirable for the control of scald.

The bruising that cherries undergo in processing plants may often be severe. A survey of 16 plants in four states, for instance, showed that the average cherry was dropped a cumulative total of 23 feet during its course from the delivery truck to the final container (17). About 70 percent of the drops were onto hard surfaces rather than into water. The data of Table 1 indicate that this amount of bruising would significantly lower the yield of pitted fruit.

TABLE 1. Effect of recurrent bruising on quality and yield of red cherries. Cherries were held for 24 hours in water at 50°F before processing (a)

Cherries	Treatment (Time and number of bruises)	Scald %	Change in weight of whole cherries, (b) %(c)	Yield of pitted cherries, (b) %(d)
1.	Control, not bruised	0	+4.2	88.7
2.	Bruised at 0 hr. (harvest)	0	−0.5	85.6
3.	Bruised at 0 and 3 hrs.	34	−5.3	80.2
4.	Bruised at 0, 3, and 6 hrs.	76	−7.9	77.2
5.	Bruised at 0, 3, 6, and 24 hrs.	74	−8.6	74.0

(a) Data are means of 4 tests in 3 years.
(b) Based on original weight of cherries at time of stem removal.
(c) Difference required for significance (5% level) = 1.6%.
(d) Difference required for significance (5% level) = 2.9%.

Weight Change

The change in weight of whole cherries and the precise time of the change are of vital concern to both grower and processor, since cherries are purchased on the basis of weight. The laboratory findings indicate that average harvest bruising alone may cause little or no change in weight in 24 hours if cherries are held continuously in 50°F. water (Table 1). Instead, the bruising may prevent a gain in weight during soaking. The 1 to 2 percent pick-up in weight associated with the first wetting of dry cherries is not included in the present values (Table 1), since cherries of all treatments were always weighed in the dry condition.

If the cherries are bruised once again as in orchard sorting, significant weight losses, chargeable to the grower, can be expected. We have observed losses as great as 3 percent during the first six hours of soaking after harvest. With cherries held in air, maximum losses were about 5 percent. Excessive orchard bruising, therefore, may penalize the grower by reducing the tonnage of delivered fruit.

After cherries have been received by a processor, additional losses in weight may follow if soaking is prolonged or bruising is recurrent. Probable extent of losses under various conditions of bruising can be estimated from the data of Table 1. In the two plant tests conducted, the average weight loss associated with unloading operations was 2.1 percent in 18 hours. The holding and soaking periods observed in four plants in 1962 ranged from 7 to 31 hours.

Although bruising may be the principal factor governing the weight changes of cherries, other factors are involved. For instance, weight changes varied with the temperature, method of handling (air or water), and nature of raw material as influenced by year and orchard.

Temperature

The retarding effect of cool post-harvest temperatures on scald development in cherries has been well established (8, 10, 12, 13, 16). Less well known are the effects of cool temperature on the change in weight of cherries and yield of pitted fruit (1, 2, 10, 15). The effects of 2 temperatures on the processing attributes of twice-bruised cherries are shown in Table 2. Lowering and maintaining the post-harvest temperature from 78°F. to 50°F. reduced the amount of scald from 61 percent to 17 percent, reduced the weight loss from 8.5 percent to 4.2 percent, and increased the yield of pitted fruit from 77.1 percent to 81.8 percent. In general, similar effects were exhibited by both air and water handled cherries.

The benefits of lowering the temperature were indeed significant. Yet it is apparent that the damaging effects of excessive bruising were not completely offset by the low temperature. Scald development and weight losses remained relatively high, and yield of pitted fruit was lower than desirable (see Table 1).

Air vs. Water

In commercial practice, questions concerning the relative merits of air and water handling of cherries continue to arise. Occasional lots of water handled cherries may exhibit more scald than lug handled lots. Investigation usually reveals, however, that the water handled fruit either was held at temperatures higher than recommended (12), or was subjected to greater bruising than lug handled fruit.

A comparison of air and water handling of cherries under equal conditions of temperature and bruising is shown in Table 2. Twice bruised cherries, handled and held in water, consistently had less weight loss (ave. = 5.0 percent vs. 7.6 percent) and higher pitted yield (ave. = 80.9 percent vs. 78.0 percent) than did fruit handled and held in air. The advantages were maintained at both a high (78°F.) and a low (50°F.) temperature. At 50°F. there was little difference in scald development in water handled and air handled fruit. At the warm (78°F.) temperature, however, scald development in the water handled fruit was greater (70.5 percent vs. 51.0 percent).

Heat Processing

The effect of the degree of bruise on the pitted weight of fresh cherries and drained weight and firmness of cooked cherries is shown in Table 3. As the degree of bruise increased, the yield of pitted fresh fruit decreased almost linearly. Maximum yield was obtained with unbruised fruit. In contrast, the drained weight (yield) of cooked fruit increased to a maximum at a bruising level equivalent to two falls from 3

TABLE 2. Effect of temperature and method of handling on quality and yield of twice bruised cherries (a)

Factor	Medium of handling and holding	Temperature 50°F	Temperature 78°F
Scald, %	air	17.3	51.0
	water	16.9	70.5
	Average	17.1	60.8
Change in weight of whole cherries (b), % (c)	air	−5.3	−9.9
	water	−3.0	−7.0
	Average	−4.2	−8.5
Yield of pitted cherries (b), % (d)	air	80.4	75.6
	water	83.1	78.6
	Average	81.8	77.1

(a) Data are mean values of 6 tests in which cherries were bruised at 0 and again at 3 hours after stem removal. Cherries were held for 24 hours prior to measurements.
(b) Based on original weight of cherries at time of stem removal.
(c) Difference required for significance (5% level) = 1.7%.
(d) Difference required for significance (5% level) = 1.3%.

TABLE 3. Effect of degree of bruise on processed yield of fresh and cooked cherries. Cherries were held for 24 hours in water at 50°F. before heat processing. Data are from 1960 season

Cherries	Bruising Treatment (Number and time of drops from 3 ft.)	Yield of pitted fresh cherries, (a) %	Drained weight of cooked cherries, (a) %	Firmness (weight retention), (b) %
1.	Control, not bruised	87.7	73.9	73.1
2.	Bruised 1 X at 0 hr.	87.1	76.5	76.5
3.	Bruised 2 X at 0 hr.	85.2	77.4	81.1
4.	Bruised 3 X at 0 hr.	80.8	74.1	81.1
5.	Bruised 2 X at 0 and 3 hrs.	79.7	74.7	82.1
6.	Bruised 2 X at 0, 3, and 6 hrs.	77.8	72.0	84.8

(a) Based on original weight of cherries at time of stem removal.
(b) Relative weight retention of cooked cherries when subjected to a standard pressure. Highest values indicate firmest tissues.

ft., and then declined as bruising was increased. The effect of heat on cherry tissues thus was modified by the degree and time of bruise (14). Unbruised cherries became relatively soft during cooking and gave low drained weight and low yield.

Whether cherries should be hot packed or cold packed is a decision that depends partly on the degree of bruise. Yields of the two kinds of packs are affected differently by bruising.

Season

Some of the year to year variations in the processing characteristics of red cherries have been described previously (1, 3, 9). The present study offered an opportunity to extend these observations. For three consecutive years cherries from the same trees were handled and processed in precisely the same manner. Differences in cherry properties accordingly were directly traceable to differences in yearly growth conditions.

In two of the three years (1960 and 1962), properties of the cherries were similar (Table 4). The flesh was firm, the cherries were bruise-resistant, and satisfactory processing yields were obtained. In the other year (1961) the flesh was relatively soft, the cherries were highly susceptible to scald and bruise damage, and the processing yield was low.

TABLE 4. Year to year variations in processing characteristics of cherries from the same orchard (a)

Factor	YEAR 1960	1961	1962
Cherries, no. per lb.	99	97	104
Soluble solids (fresh fruit), %	14.8	13.7	14.3
Scalded cherries (24 hrs.), %	32	43	23
Weight change (whole cher., 24 hrs.), %(b)	−1.9	−6.0	−3.3
Yield of pitted cherries, %(b)	82.0	78.4	82.7
Drained weight (hot pack), %(b)	74.7	65.2	74.3
Firmness (hot pack), %(c)	81.2	74.6	81.1

(a) Data are means of 8 handling and bruising treatments repeated each year.

(b) Based on original weight of cherries at time of stem removal.

(c) Relative weight retention of drained cherries on a sieve when subjected to a standard pressure. Highest values indicate firmest fruit.

These data indicate that handling, holding, and bruising conditions which are acceptable one year may not be acceptable in another year. In developing new methods, therefore, it is desirable to strive for anti-bruise conditions that will accommodate soft as well as firm cherries.

SUMMARY

Laboratory studies on recurrent bruising of red tart cherries were carried out for three seasons. Cherries were bruised by a standard method at four intervals which corresponded to harvest time, handling at the receiving station, unloading at the processing plant, and handling during processing.

The effects of bruising were cumulative. If cherries were bruised only once (as in mechanical harvest), they did not scald during a 24 hour period at 50°F. If after a delay they were bruised once again, they developed scald blemishes. As the number of recurrent bruises increased, the cherries decreased in fresh weight and in yield of pitted product. The decreases were greater at 78°F. than at 50°F., and were greater also with air handled fruit than with water handled fruit. Maximum yield of pitted fresh cherries was obtained from unbruised fruit handled and held in water at 50°F. Maximum yield (drained weight) of cooked cherries, however, was obtained from fruit which was bruised once. The cooked tissues of bruised fruit were relatively firm. In 1 of the 3 years of the study, the cherries were particularly susceptible to bruise damage.

The results emphasize the importance of controlling bruising as well as temperature in the post-harvest handling of cherries. Since bruising in a processing plant and bruising in an orchard may have equally detrimental effects, close cooperation between processor and grower in minimizing bruising is desirable.

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